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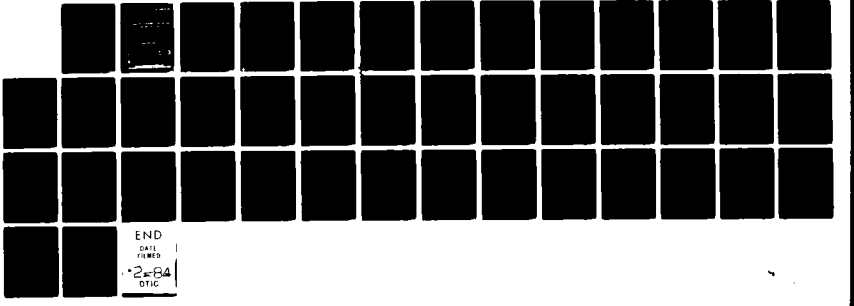

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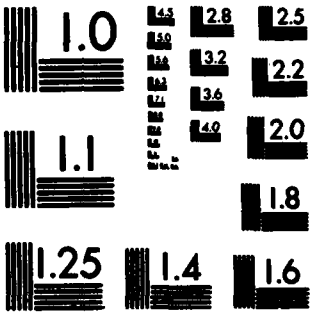

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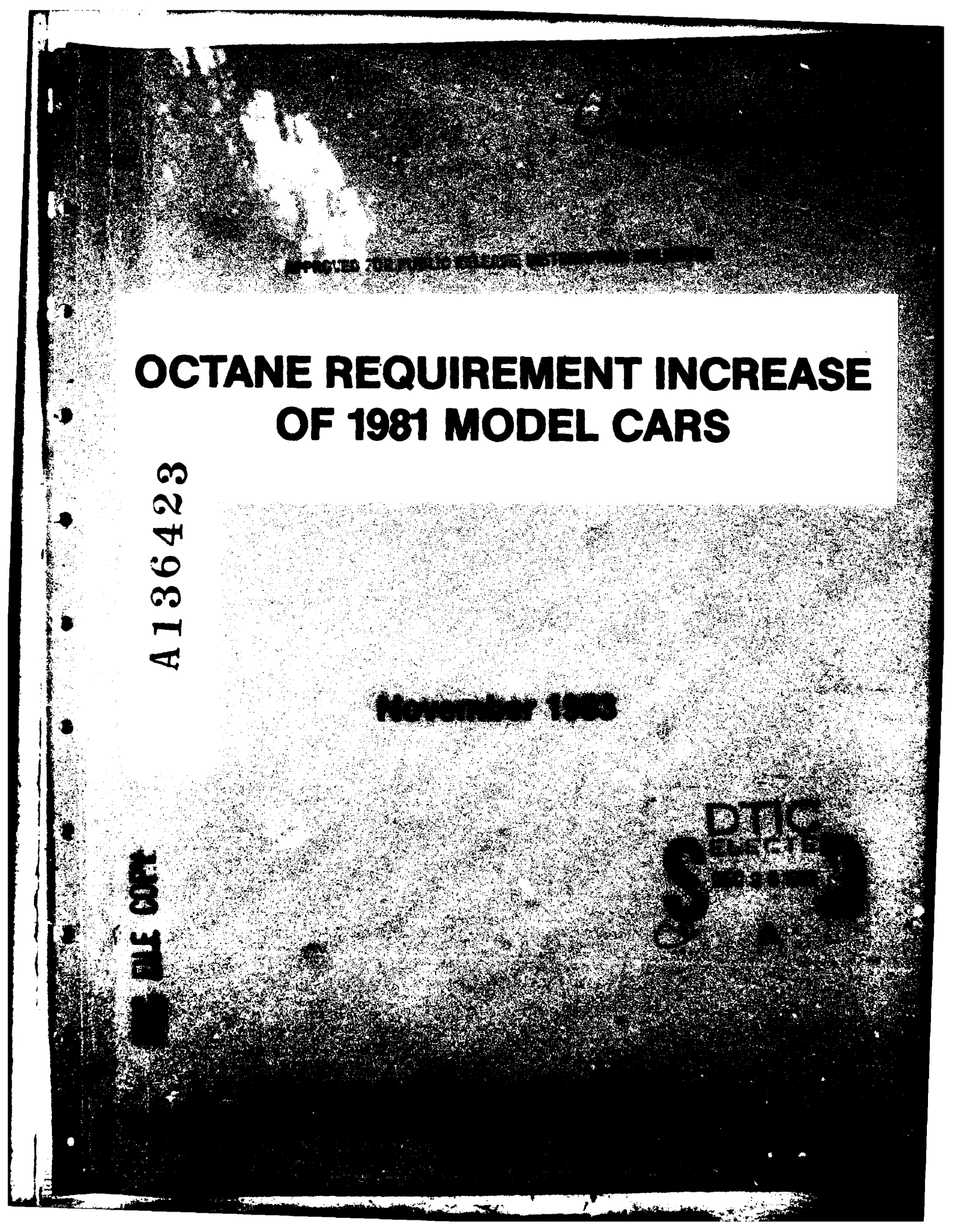
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OCTANE REQUIREMENT INCREASE OF 1981 MODEL CARS

(CRC PROJECT No. CM-124-81)

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Prepared by the

1981 Octane Requirement Increase Analysis Panel

of the

CRC Light-Duty Octane Technology and Test Procedures Group

November 1983

Light-Duty Vehicle Fuel, Lubricant, and Equipment Research Committee

of the

Coordinating Research Council, Inc.

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SUMMARY:

Findings include:

- Octane requirement increase (ORI) was determined for eighty-six 1981 model cars operated on unleaded gasoline. All ORI values were determined from the increase in maximum octane requirements irrespective of whether requirements were obtained at full- or part-throttle.

- At 15,000 miles, the mean ORI for all cars with full-boiling range unleaded (FBRU) fuels was 5.1 Research octane numbers, 3.3 Motor octane numbers, and 4.2 (R+M)/2 numbers.

- At 15,000 miles, the mean ORI for seventy-four cars with full-boiling range high sensitivity unleaded (FBRSU) fuels was 5.2 Research octane numbers, 3.6 Motor octane numbers, and 4.4 (R+M)/2 numbers.

- At 15,000 miles, the mean ORI for seventy-four cars with primary reference fuels (PRF) was 4.1 octane numbers.

- Compared with 1980 models (120 cars), the mean ORI for all cars in the 1981 program with FBRU fuels was the same on a RON basis, and 0.1 MON higher.

- In general, the mean ORI with FBRU fuels has not changed appreciably for the 1975 through 1981 model cars. and,

- ORI decreases about 0.2 to 0.3 octane number per octane number increase of initial octane requirements; this relationship is statistically significant.

II. INTRODUCTION

The need to study octane requirement increase (ORI) with unleaded fuel became evident in 1970 when manufacturers announced that cars would require catalytic converters and use unleaded gasoline of at least 91 RON quality to meet future emission standards. Since that time, manufacturers have made many engine modifications to meet both exhaust emission and fuel economy standards. Because of these engine design changes and the increasing use of unleaded gasoline, the Coordinating Research Council, Inc. (CRC) initiated a series of ORI programs in 1971.

The ORI data from 1971 and 1973 through 1980 model cars have been reported previously.[1-6] This report will summarize ORI data for 1981 model cars.

top. 1

III. EXPERIMENTAL

A. Cars Tested

In the 1981 program, seventy-four US and twelve imported cars were used to determine the ORI of 1981 model cars. Cars tested were not selected to represent the distribution of vehicles produced in that model year; rather the data base consists of information volunteered by participants. Data on cars that did not complete 15,000 miles of testing were excluded from the analysis. Participating laboratories are listed in Appendix A.

B. Mileage Accumulation

Mileage accumulation was conducted from the fall of 1980 through the fall of 1982. All test cars were operated in customer-type service using unleaded fuels typical of commercially available gasoline. No attempt was made to separate the data so that fuel-to-fuel or laboratory-to-laboratory effects could be determined.

C. Unleaded Average Sensitivity Full-Boiling Range Reference Fuels (FBRU)

In general, octane number requirements of 1981 model cars were defined initially with 1980 FBRU fuels. As mileage increased, the reference fuels were replaced with the 1981 FBRU fuels. Some laboratories, however, used 1980 or 1981 reference fuels for all requirements. Laboratory X used a third FBRU reference fuel series for all octane requirements it submitted. Laboratory Y used 1979 and 1981 FBRU fuels. The RON-to-MON conversions used in the data analysis for 1981 cars are shown in Appendix C, Table C-I.

D. High Sensitivity Unleaded Full-Boiling Range Reference Fuels (FBRSU)

Octane requirements of seventy-four cars were defined initially with 1980 FBRSU fuels and later with 1981 FBRSU fuels as well as with FBRU and Primary Reference (PR) fuels. Laboratory Y used 1979 and 1981 FBRSU fuels, and some laboratories used either 1980 or 1981 FBRSU fuels exclusively. The RON-to-MON conversions used in the data analysis are shown in Appendix C, Table C-II.

E. Primary Reference (PR) Fuels

Standard ASTM PR fuels were used in two octane number increments from 76 to 82, and in one octane number increments from 82 to 100, to cover the range of car requirements.

F. Test Technique

Octane number requirements were determined at incremental mileages from zero to 15,000 miles by the CRC E-15-81 technique.[9] Maximum octane number requirements were determined on eighty-six cars with FBRU fuels, and on seventy-four cars with FBRSU and PR fuels.

IV. DISCUSSION OF RESULTS

A. Data Analysis Technique

For this program, octane requirements were to be obtained at 0, 5,000, 10,000, and 15,000 miles; however, not all the data were obtained exactly at these mileage intervals. To compare the ORI of all cars at the same mileage, results were determined from best-fit curves of actual reported octane requirements. Research octane number requirements (RON) reported by the participants were plotted at the mileages at which they were obtained. Requirements at 0, 5,000, 10,000, and 15,000 miles were then read from best-fit curves as shown in Figure 1. ORI at 5,000, 10,000, and 15,000 miles were determined from these best-fit-curve requirements.

ORI on a Motor octane number (MON) basis was determined from best-fit-curve RON requirements that were translated into MON requirements according to the RON-to-MON conversions in Tables C-I and C-II. Similarly, ORI on an (R+M)/2 basis was determined from (R+M)/2 requirements that were calculated from best-fit-curve RON and corresponding MON values. The appropriate RON-to-MON conversion was determined by the fuel series used to determine the actual reported requirement that was closest to the 0-, 5,000-, 10,000-, or 15,000-mile interval. In general, requirements were determined initially on 1980 fuels and later on 1981 fuels; however, some laboratories measured all requirements with either 1980 or 1981 fuels. Laboratory X used a third FBRU reference fuel series; all data reported by this laboratory were translated according to the Laboratory X RON-to-MON conversion in Table C-I. Laboratory Y initially determined requirements of 1981 cars on 1979 fuels, and later on 1981 fuels.

Best-fit-curve octane requirements at 0, 5,000, 10,000, and 15,000 miles are listed for each car in Appendix D, Tables D-I, D-II, and D-III for FBRU, FBRSU, and PR fuels, respectively. Copies of raw octane requirement data and best-fit curves are on file with CRC.

Distribution of initial RON, MON, and (R+M)/2 requirements, as well as ORI values for each mileage interval, are summarized in Tables I, II, and III for FBRU, FBRSU, and PR fuels, respectively. The numbers in parenthesis in Table I are the average FBRU ORI values of cars for which data on FBRSU and PR fuels were also reported.

Distributions of initial RON requirements are plotted in Figure 2 for all three fuel series. Distributions of ORI at various mileages for RON, MON, and (R+M)/2 on FBRU fuels are shown in Figures 3, 4, and 5, respectively, and on FBRSU fuels in Figures 6, 7, and 8. Similarly, distribution of ORI on PR fuels at various mileages are shown in Figure 9.

Because some laboratories tested cars on two different reference fuel series, the MON ORI may be different from that determined from a single reference fuel series. The difference in sensitivity (RON minus MON) ranges from 0.0 to 1.5 and 0.1 to 0.9 for the four FBRU and three FBRSU fuel series, respectively. Although an estimate of the error cannot be made from these data, work by other researchers suggest it may be as much as 0.5 MON.[10]

Members of the Analysis Panel are listed in Appendix B.

B. Comparison of 1975 through 1981 ORI Studies

The mean ORI values for 1975 through 1981 model cars are:

Model Year	Accumulated Miles	Mean ORI FBRU, RON	Mean ORI PRF
1975	16,000	5.8	4.4
1976	15,000	5.4	3.6
1977	15,000	4.9	2.9
1978	15,000	6.0	4.2
1979	15,000	5.4	4.1
1980	15,000	5.1	3.9
1981	15,000	5.1	4.1
1975-1981 Unweighted Average:		5.4	3.9

Except for the 1977 PR fuel data, the mean ORI value has not changed appreciably from 1975 to 1981.

C. ORI Versus Initial Octane Requirements

Initial RON requirements are plotted against ORI at 15,000 miles in Figures 10, 11, and 12 for FBRU, FBRSU, and PR fuels, respectively. The correlation between initial requirements and ORI was determined by linear least squares regression analysis. The general form of the equation was:

$$ORI = a + b\,(\text{Initial Octane Requirement})$$

The best-fit lines are also shown in Figures 10, 11, and 12.

Equations for the three reference fuel series are:

Reference Fuel Series	a Estimate	a T Value of Estimate	b Estimate	b T Value of Estimate	R^2
FBRU	29.5	6.0	-0.27	5.0	0.22
FBRSU	31.9	6.2	-0.30	5.2	0.26
PR	26.9	5.4	-0.26	4.6	0.21

In general, ORI decreases about 0.2 to 0.3 units per unit increase of initial requirements. Although the correlation coefficients (R^2) are small, the analysis indicates that the estimates of the slope (ORI/Initial Requirement) are statistically significant. This phenomenon was observed and reported in the previous CRC ORI study.[8]

REFERENCES

REFERENCES

1. Coordinating Research Council, Inc., "Influence of Leaded and Unleaded Fuels on Octane Requirement Increase in 1971 Model Cars," CRC Report No. 445, March 1971.

2. Coordinating Research Council, Inc., "Octane Requirement Increase in 1973 Model Cars," CRC Report No. 476, February 1975.

3. Coordinating Research Council, Inc., "Octane Requirement Increase in 1974 Model Cars," CRC Report No. 485, June 1976.

4. Coordinating Research Council, Inc., "Octane Requirement Increase in 1975 Model Cars," CRC Report No. 498, July 1978.

5. Octane Requirement Increase in 1976 Model Cars, CRC Road Test Group Informal Study by J. D. Rogers, Jr., October 1979.

6. Coordinating Research Council, Inc., "Octane Requirement Increase in 1977 Model Cars," CRC Report No. 513, April 1980.

7. Coordinating Research Council, Inc., "Octane Requirement Increase of 1978 and 1979 Model Cars," CRC Report No. 526, April 1982.

8. Coordinating Research Council, Inc., "Octane Requirement Increase of 1980 Model Cars," CRC Report No. 531, June 1983.

9. Coordinating Research Council, Inc., "1981 CRC Octane Number Requirement Survey," CRC Report No. 525, August 1982.

10. Correspondence to R. K. Nelson (CRC) from L. M. Gibbs (Chevron Research Company), May 16, 1983, "1980 CRC Octane Requirement Increase Program."

TABLES

AND

FIGURES

TABLE I

INITIAL OCTANE REQUIREMENTS AND ORI AT VARIOUS MILEAGES -- FBRU FUELS

Group	No. of Cars Tested	RON Initial Requirements Mean	RON Initial Requirements SD	RON 5,000-Mile ORI Mean	RON 5,000-Mile ORI SD	RON 10,000-Mile ORI Mean	RON 10,000-Mile ORI SD	RON 15,000-Mile ORI Mean	RON 15,000-Mile ORI SD	MON Initial Requirements Mean	MON Initial Requirements SD	MON 5,000-Mile ORI Mean	MON 5,000-Mile ORI SD	MON 10,000-Mile ORI Mean	MON 10,000-Mile ORI SD	MON 15,000-Mile ORI Mean	MON 15,000-Mile ORI SD	(R+M)/2 Initial Requirements Mean	(R+M)/2 Initial Requirements SD	(R+M)/2 5,000-Mile ORI Mean	(R+M)/2 5,000-Mile ORI SD	(R+M)/2 10,000-Mile ORI Mean	(R+M)/2 10,000-Mile ORI SD	(R+M)/2 15,000-Mile ORI Mean	(R+M)/2 15,000-Mile ORI SD
All Cars	86	87.4	4.0	3.4	1.6	4.6	2.1	5.1	2.4	80.7	2.8	2.1	1.1	2.8	1.4	3.3	1.6	84.1	3.4	2.8	1.4	3.7	1.7	4.2	2.0
	(74)	(87.6)	(4.0)	(3 3)	(1.6)	(4.6)	(2.0)	(5.2)	(2.2)	(80.9)	(2.7)	(2.0)	(1.0)	(2.7)	(1.3)	(3.3)	(1.5)	(84.2)	(3.4)	(2.7)	(1.3)	(3.7)	(1.6)	(4.2)	(1.8)
All Make A	16	89.3	3.7	2.8	1.1	4.0	1.9	4.6	2.5	82.0	2.6	1.7	0.8	2.5	1.3	3.0	1.7	85.6	3.1	2.3	1.0	3.3	1.6	3.8	2.1
All Make B	18	86.8	4.5	3.4	1.9	4.6	2.4	5.2	2.7	80.4	3.0	2.1	1.2	2.8	1.6	3.3	1.7	83.6	3.7	2.8	1.6	3.7	2.0	4.2	2.2
All Make C	38	87.1	4.2	3.5	1.7	4.7	2.1	5.2	2.5	80.6	3.0	2.3	1.2	3.1	1.5	3.4	1.8	83.8	3.6	2.9	1.4	3.9	1.8	4.3	2.1
	(26)	(87.6)	(4.3)	(3.4)	(1.6)	(4.7)	(1.9)	(5.4)	(2.2)	(81.1)	(2.9)	(2.1)	(1.1)	(2.9)	(1.3)	(3.3)	(1.5)	(84.3)	(3.6)	(2.7)	(1.3)	(3.8)	(1.6)	(4.3)	(1.8)
All Others	14	86.6	2.8	3.7	1.5	5.0	1.5	5.5	1.5	80.3	2.0	2.2	0.9	2.8	1.0	3.4	1.1	83.4	2.4	3.0	1.2	3.9	1.2	4.4	1.2
Engine A16	9	89.9	4.8	2.5	1.3	3.7	2.3	4.4	3.2	82.6	3.3	1.6	1.0	2.3	1.7	2.8	2.1	86.2	4.0	2.1	1.1	3.0	1.9	3.6	2.6
Engine B22	12	85.5	4.3	3.6	2.1	4.9	2.6	5.6	2.9	79.6	2.6	2.3	1.3	3.1	1.7	3.7	1.6	82.6	3.4	2.9	1.7	4.0	2.1	4.6	2.3
Engine C25	8	88.8	3.4	4.6	1.2	5.8	1.4	6.2	1.5	81.6	2.1	3.1	0.9	3.8	1.1	4.1	1.0	85.2	2.7	3.9	1.0	4.8	1.2	5.1	1.2
	(5)	(89.7)	(4.2)	(4.4)	(1.2)	(5.6)	(1.5)	(6.0)	(1.7)	(82.3)	(2.5)	(2.8)	(0.8)	(3.5)	(1.1)	(3.8)	(0.9)	(86.0)	(3.3)	(3.6)	(1.0)	(4.5)	(1.3)	(4.9)	(1.2)
Engine C28	10	83.1	2.3	3.5	1.4	4.6	1.6	5.0	1.8	77.7	2.1	2.5	1.1	3.2	1.1	3.5	1.2	80.4	2.2	3.0	1.2	3.9	1.4	4.3	1.5
	(6)	(84.4)	(1.8)	(3.4)	(1.4)	(4.7)	(1.6)	(5.4)	(1.7)	(79.0)	(1.5)	(2.2)	(0.9)	(3.0)	(1.0)	(3.4)	(1.1)	(81.7)	(1.6)	(2.8)	(1.1)	(3.9)	(1.2)	(4.4)	(1.4)
Engine C38	5	88.4	4.8	2.6	1.3	4.1	1.2	4.8	1.3	81.5	3.5	1.6	0.9	2.5	0.8	2.9	0.9	84.9	4.1	2.1	1.1	3.3	1.0	3.9	1.1
	(4)	(88.5)	(5.5)	(2.7)	(1.4)	(4.2)	(1.3)	(4.9)	(1.4)	(81.5)	(4.0)	(1.5)	(1.0)	(2.4)	(1.0)	(2.9)	(1.1)	(85.0)	(4.8)	(2.1)	(1.2)	(3.3)	(1.2)	(3.9)	(1.3)

( ) Numbers in parentheses represent FBRU data on cars that also were rated on FBRSU and PR Fuels.

TABLE II

INITIAL OCTANE REQUIREMENTS AND ORI AT VARIOUS MILEAGES -- FBRSU FUELS

Group	No. of Cars Tested	RON								MON								(R+M)/2							
		Initial Requirements		5,000-Mile ORI		10,000-Mile ORI		15,000-Mile ORI		Initial Requirements		5,000-Mile ORI		10,000-Mile ORI		15,000-Mile ORI		Initial Requirements		5,000-Mile ORI		10,000-Mile ORI		15,000-Mile ORI	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
All Cars	74	88.8	4.3	3.3	1.7	4.6	2.1	5.2	2.5	79.8	2.7	2.1	1.4	3.1	1.7	3.6	2.0	84.3	3.5	2.7	1.3	3.9	1.7	4.4	2.0
All Make A	16	90.2	3.9	3.0	1.2	4.2	1.9	4.9	2.4	80.7	2.4	1.9	0.8	2.9	1.2	3.4	1.6	85.4	3.1	2.4	1.0	3.6	1.5	4.1	2.0
All Make B	18	87.8	4.9	3.4	2.6	4.7	2.5	5.4	3.0	79.2	3.1	2.2	1.4	3.2	1.5	3.8	1.9	83.5	4.0	2.8	1.7	3.9	2.0	4.6	2.4
All Make C	26	89.3	4.4	3.3	1.8	4.5	2.3	5.1	2.7	80.2	2.8	2.0	1.1	3.0	1.4	3.5	1.7	84.7	3.6	2.7	1.4	3.8	1.8	4.3	2.2
All Others	14	87.7	3.5	3.8	1.2	5.1	1.3	5.6	1.4	79.1	2.2	2.4	0.8	3.4	0.7	3.8	0.8	83.4	2.9	3.1	1.0	4.2	1.0	4.7	1.1
Engine A16	9	91.0	5.0	2.8	1.4	4.1	2.2	4.9	2.9	81.2	3.0	1.8	0.9	2.9	1.4	3.4	1.9	86.1	4.0	2.3	1.1	3.5	1.7	4.1	2.4
Engine B22	12	86.3	4.5	3.7	2.1	5.1	2.6	6.0	3.3	78.2	2.9	2.4	1.4	3.4	1.7	4.1	2.1	82.2	3.7	3.1	1.7	4.2	2.2	5.1	2.7
Engine C25	5	90.5	3.5	4.5	1.2	6.1	1.9	6.9	2.5	81.0	2.0	2.7	0.6	3.8	0.7	4.7	1.4	85.7	2.8	3.6	0.9	5.0	1.2	5.8	1.9
Engine C28	6	86.3	2.5	3.1	1.5	4.4	1.9	5.1	2.2	78.4	1.8	1.9	0.9	2.9	1.3	3.2	1.6	82.3	2.1	2.5	1.2	3.6	1.6	4.1	1.9
Engine C30	4	90.5	5.8	3.0	2.7	4.0	3.1	4.4	3.1	80.8	3.6	2.1	1.5	2.9	2.0	3.1	2.0	85.7	4.7	2.6	2.1	3.4	2.5	3.8	2.5

TABLE III

INITIAL OCTANE NUMBER REQUIREMENTS AND ORI AT VARIOUS MILEAGES -- PR FUELS

Group	No. of Cars Tested	Initial Requirements Mean	SD	5,000-Mile ORI Mean	SD	10,000-Mile ORI Mean	SD	15,000-Mile ORI Mean	SD
All Cars	74	86.2	3.5	2.6	1.4	3.6	1.7	4.1	2.0
All Make A	16	88.6	3.6	2.5	1.0	3.5	1.7	4.1	2.4
All Make B	18	85.5	3.9	2.4	1.8	3.2	2.0	3.5	2.2
All Make C	26	85.7	3.2	2.7	1.0	3.8	1.3	4.3	1.6
All Others	14	85.5	2.4	2.8	1.8	3.9	1.9	4.4	1.8
Engine A16	9	89.2	4.6	2.4	1.1	3.5	2.0	4.1	2.9
Engine B22	12	84.6	3.9	2.6	1.8	3.5	2.1	3.9	2.2
Engine C25	5	88.0	3.1	3.4	0.8	4.5	0.9	4.9	0.9
Engine C28	6	83.0	2.2	2.4	0.5	3.8	0.8	4.5	1.0
Engine C38	4	86.3	3.5	2.0	0.8	2.8	1.3	3.1	1.7

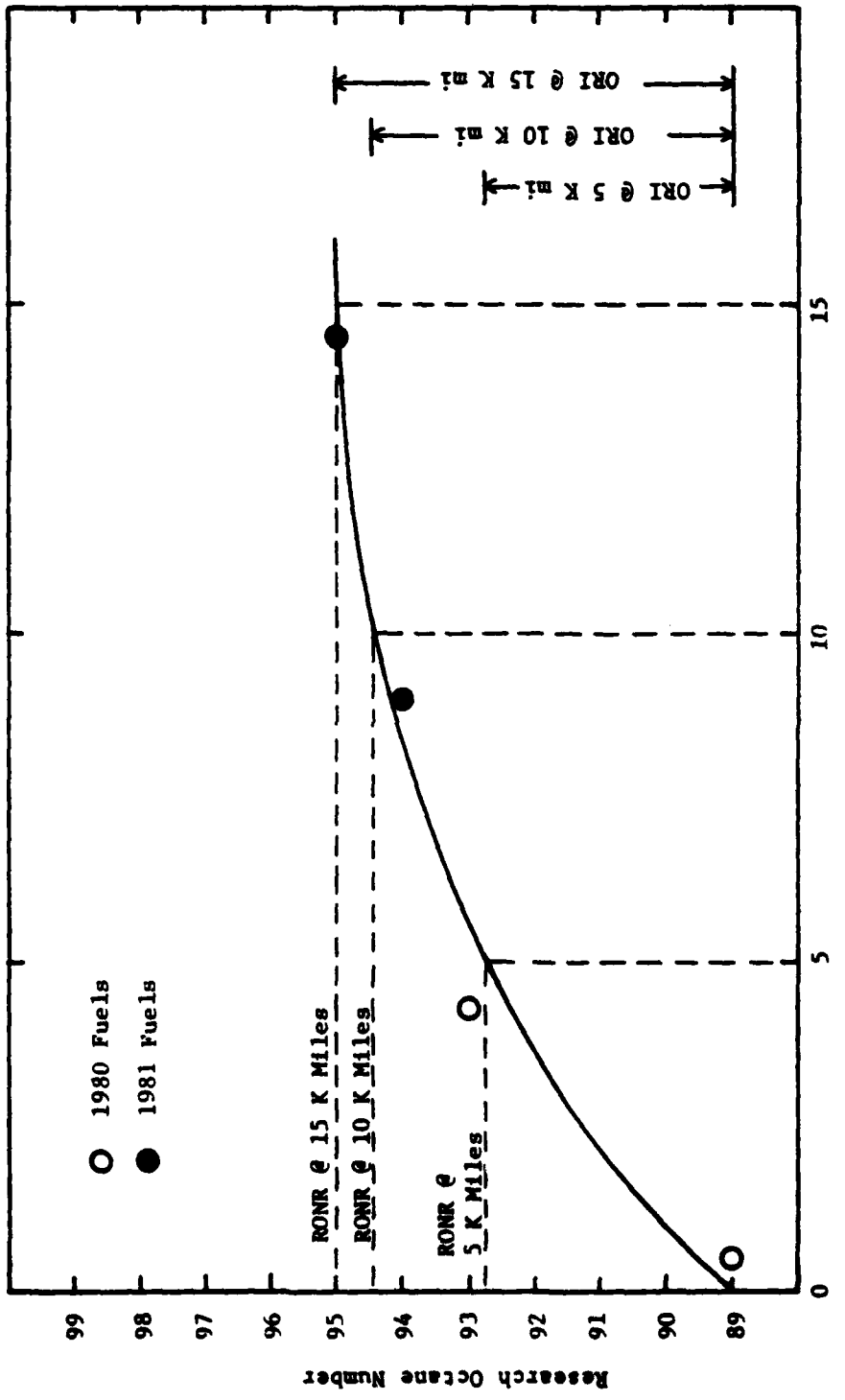


FIGURE 1

BEST-FIT-CURVE ORI ANALYSIS

FIGURE 2

DISTRIBUTION OF INITIAL RON REQUIREMENTS
FOR 1981 MODEL CARS

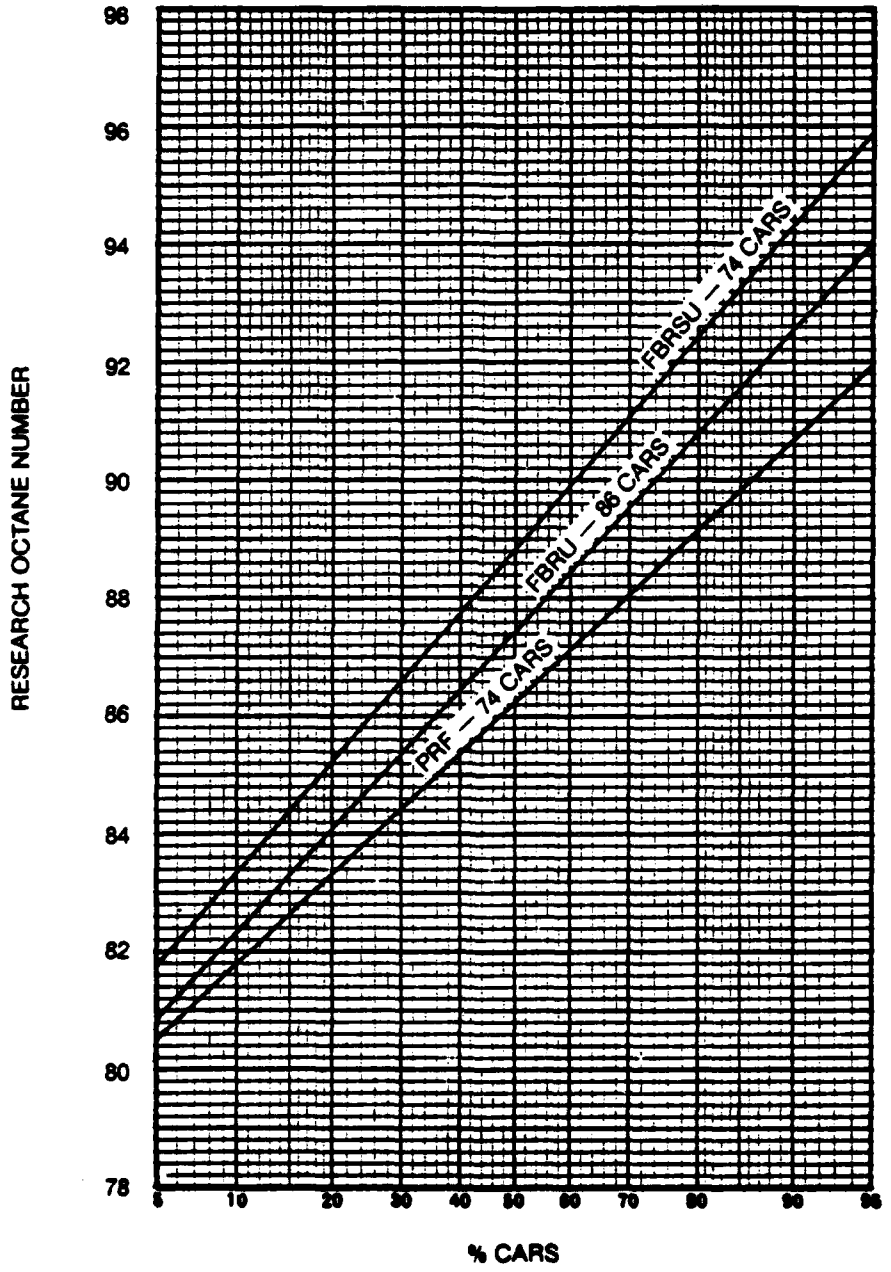


FIGURE 3

DISTRIBUTION OF RON ORI FOR
86 1981 MODEL CARS AT
VARIOUS MILEAGES ON FBRU FUELS

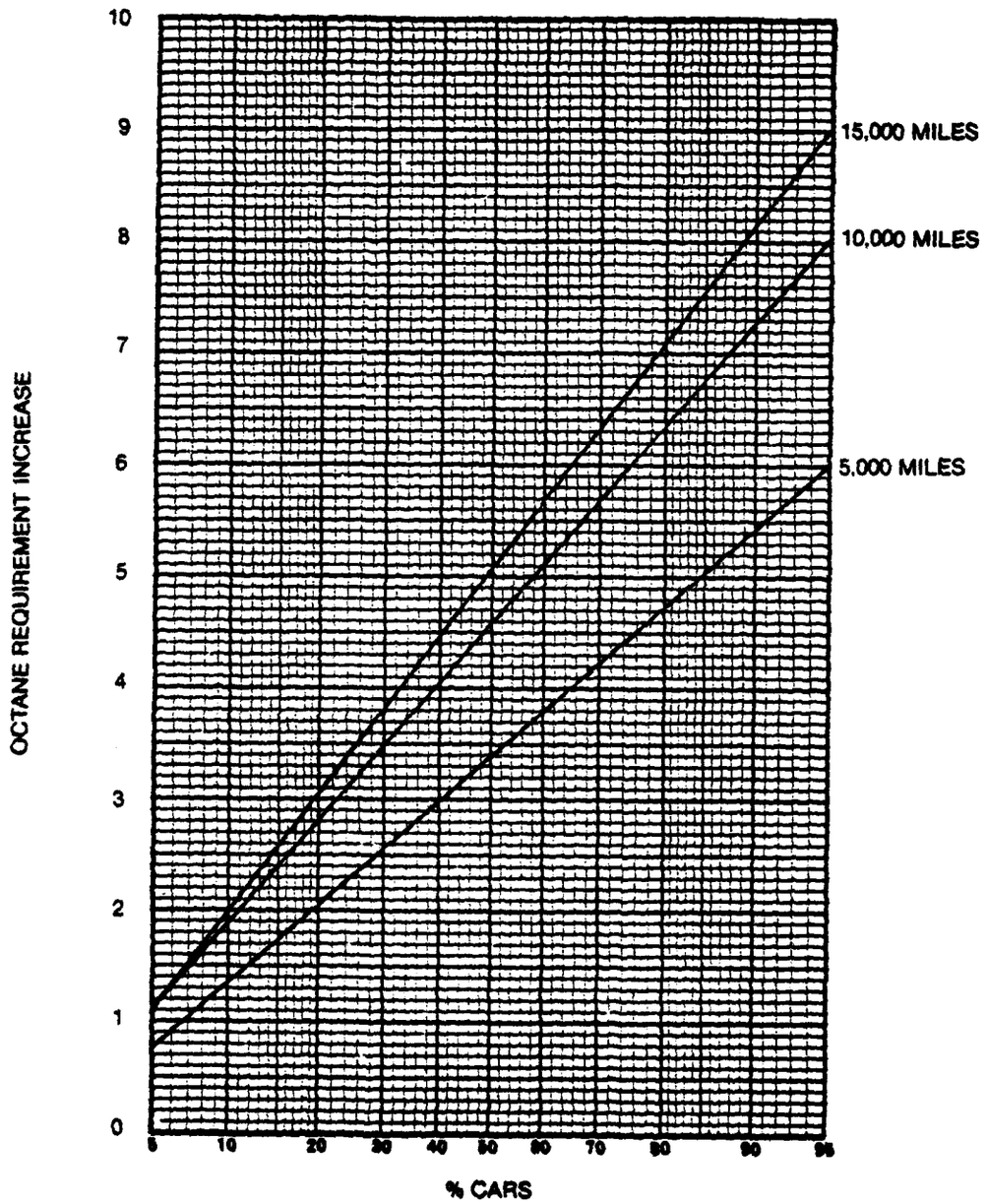


FIGURE 4

DISTRIBUTION OF MON ORI FOR
86 1981 MODEL CARS AT
VARIOUS MILEAGES ON FBRU FUELS

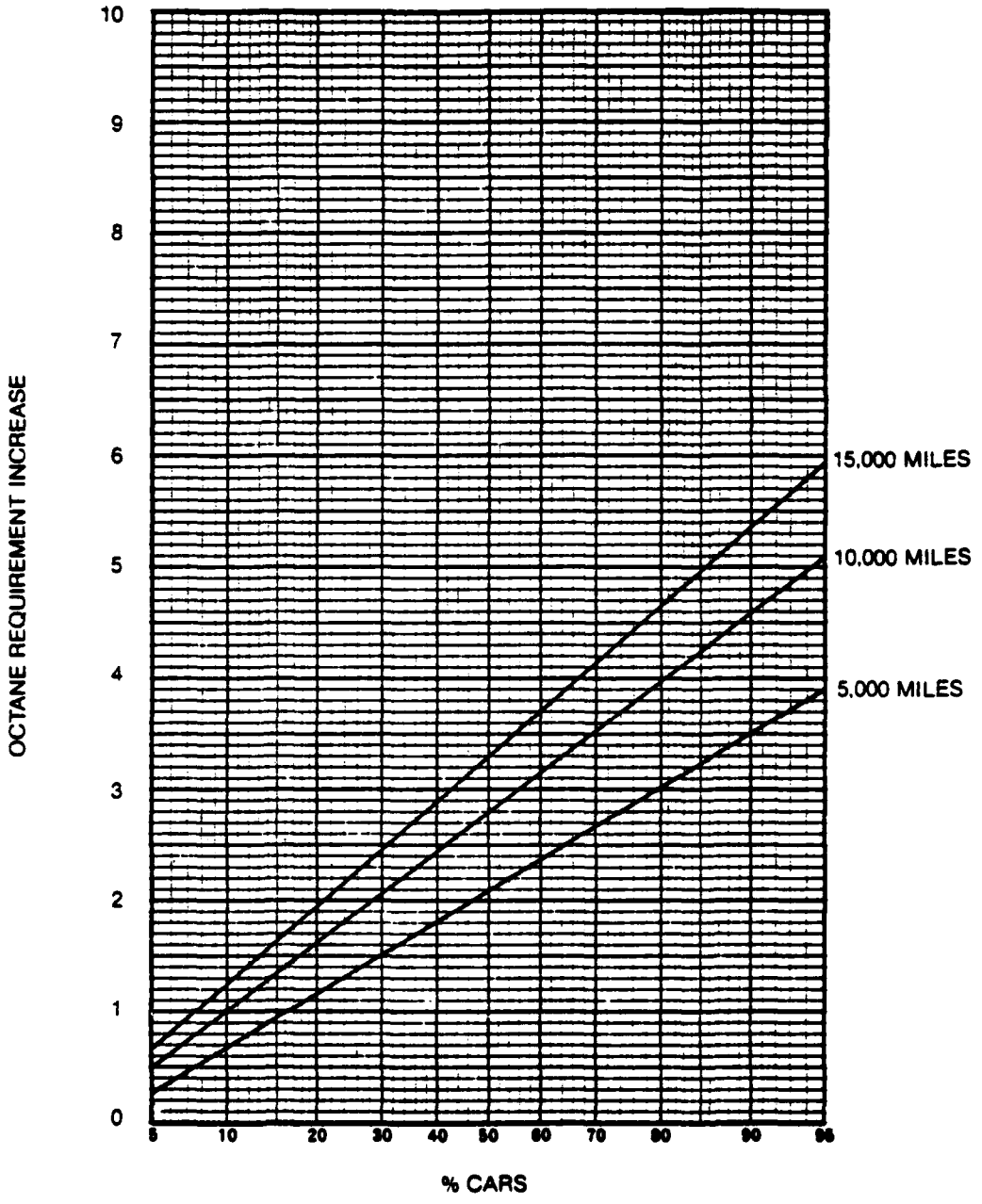


FIGURE 5

DISTRIBUTION OF (R+M)/2 ORI FOR
86 1981 MODEL CARS AT
VARIOUS MILEAGES ON FBRU FUELS

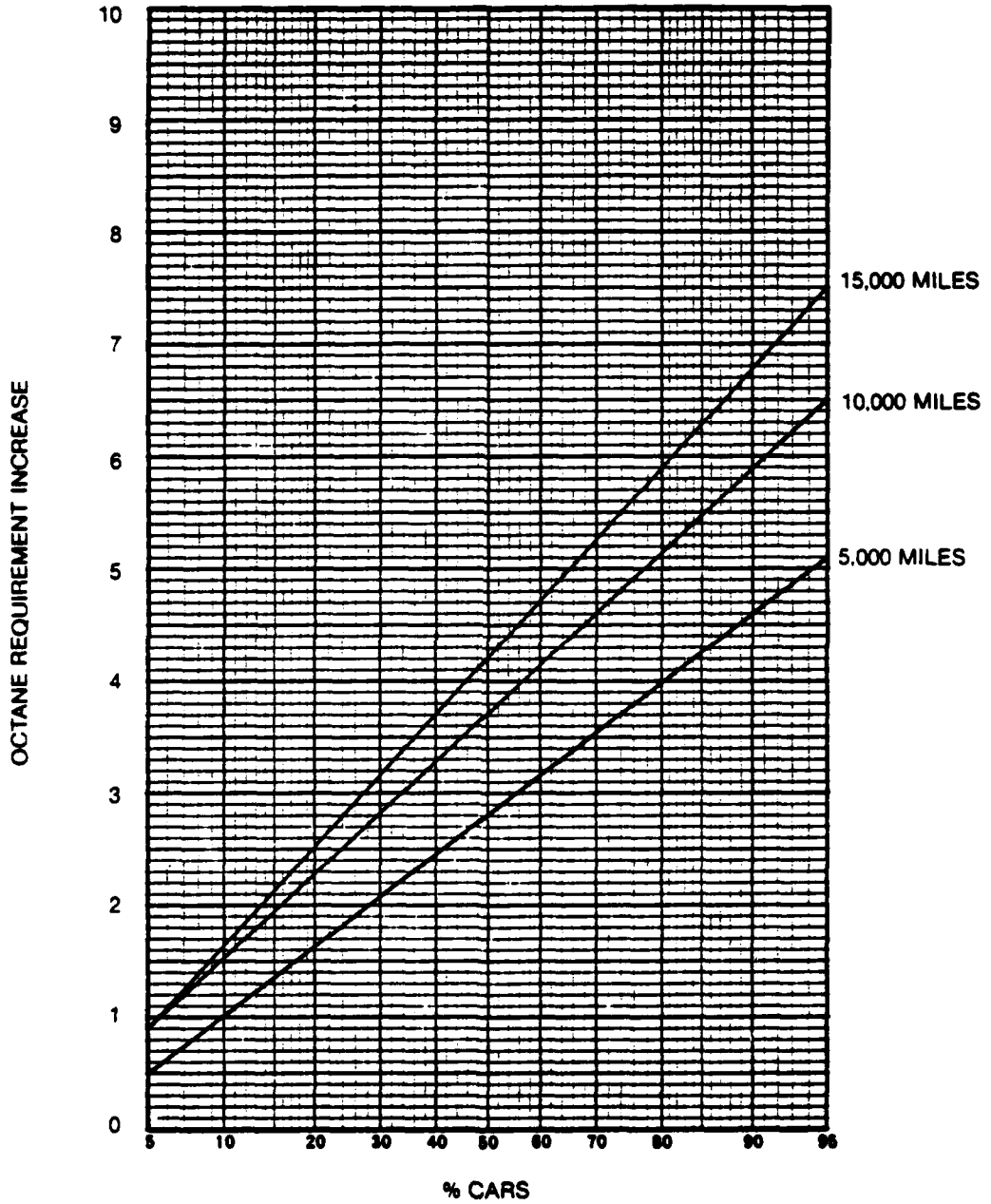


FIGURE 6

DISTRIBUTION OF RON ORI FOR
74 1981 MODEL CARS AT
VARIOUS MILEAGES ON FBRSU FUELS

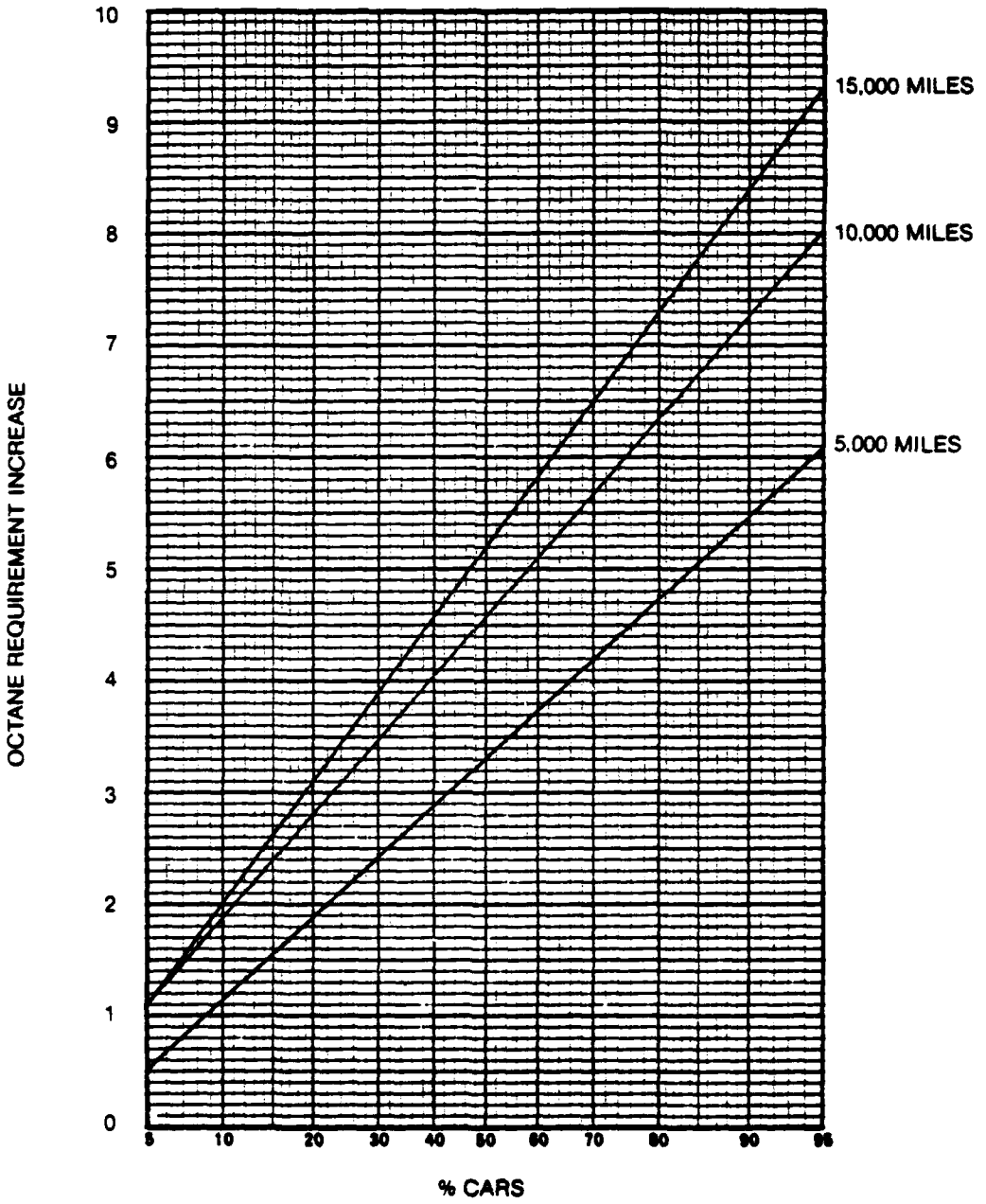


FIGURE 7

DISTRIBUTION OF MON ORI FOR
74 1981 MODEL CARS AT
VARIOUS MILEAGES ON FBRSU FUELS

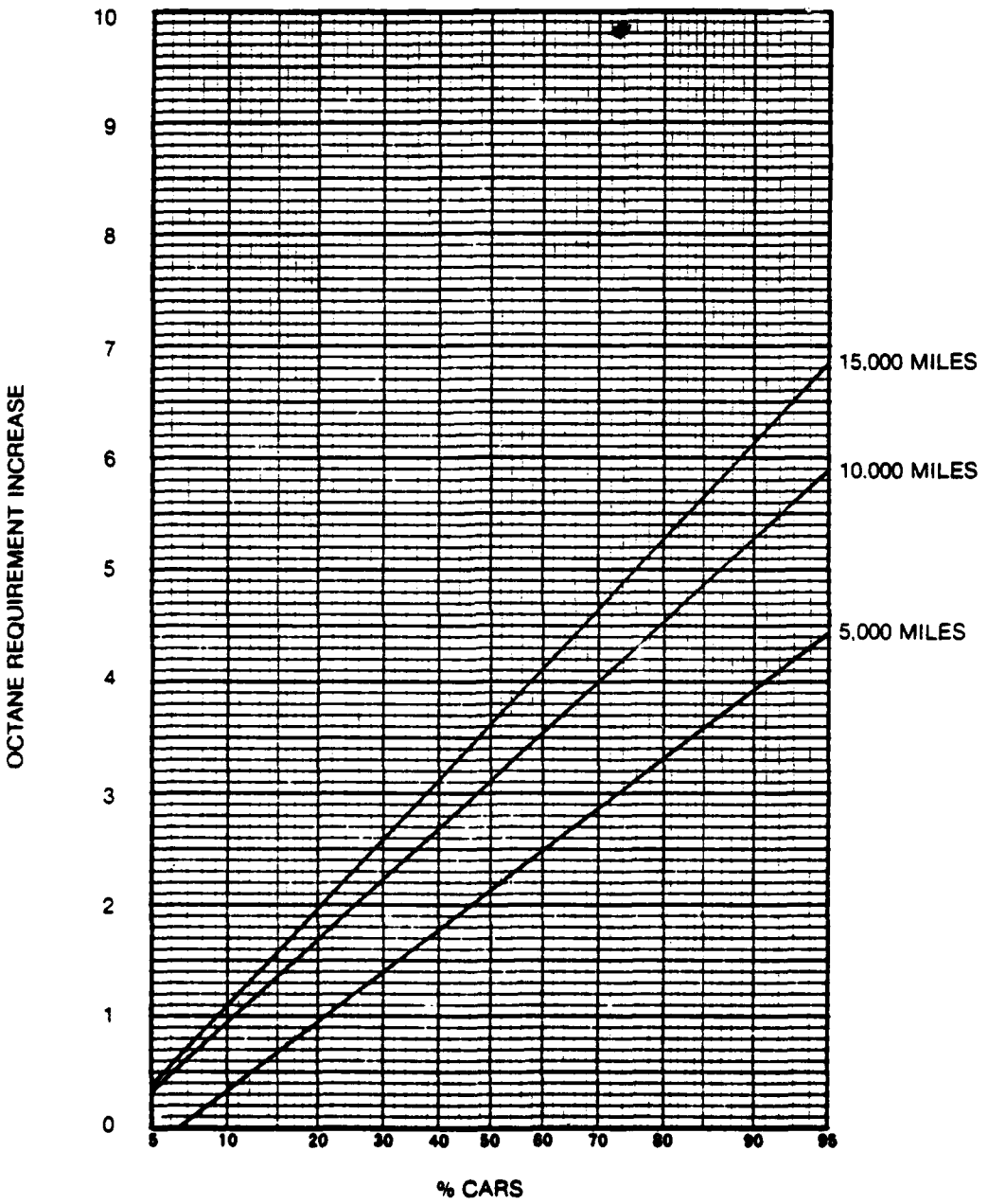


FIGURE 8

DISTRIBUTION OF (R+M)/2 ORI FOR
74 1981 MODEL CARS AT
VARIOUS MILEAGES ON FBRSU FUELS

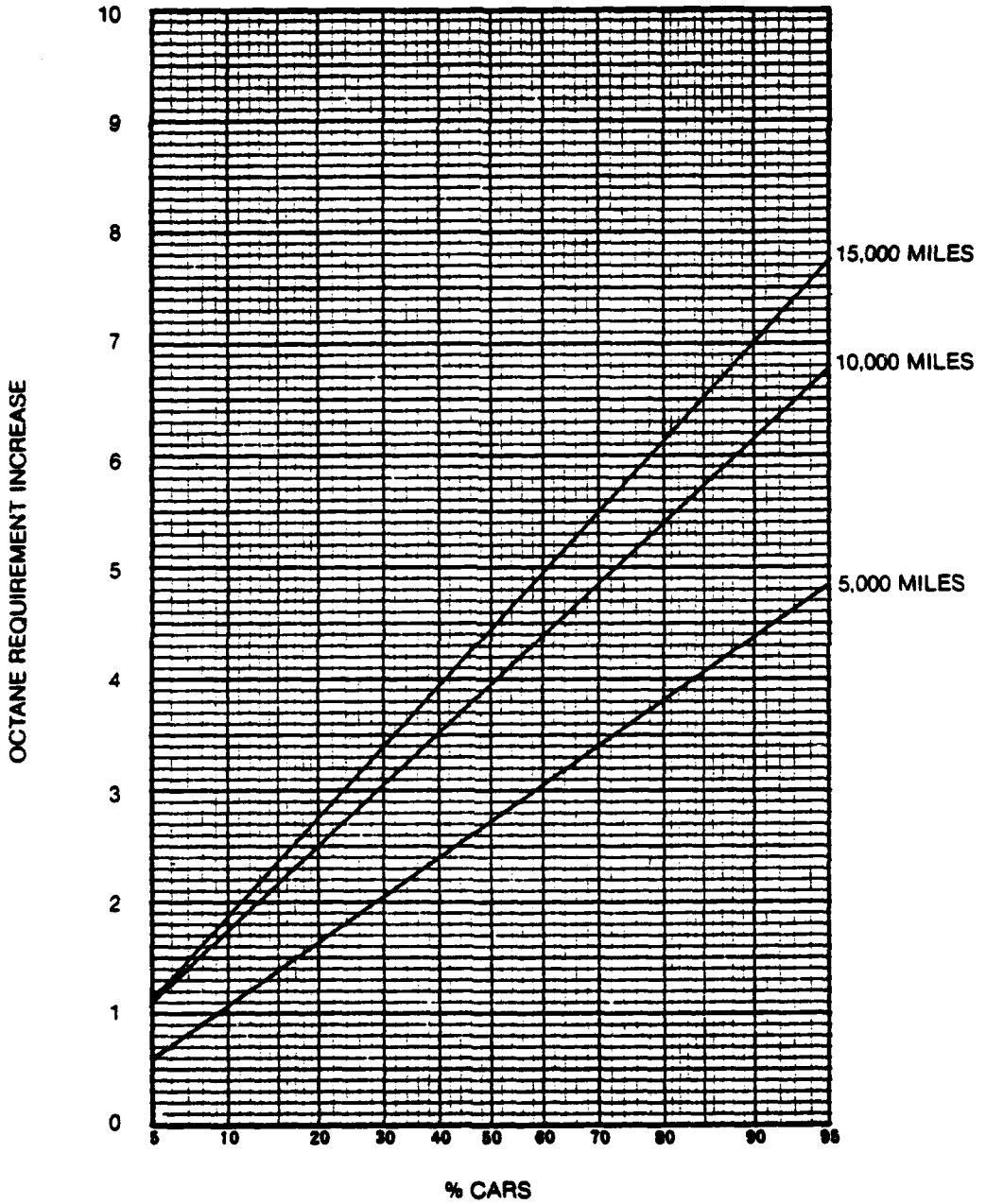


FIGURE 9

DISTRIBUTION OF ORI FOR
74 1981 MODEL CARS AT
VARIOUS MILEAGES ON PR FUELS

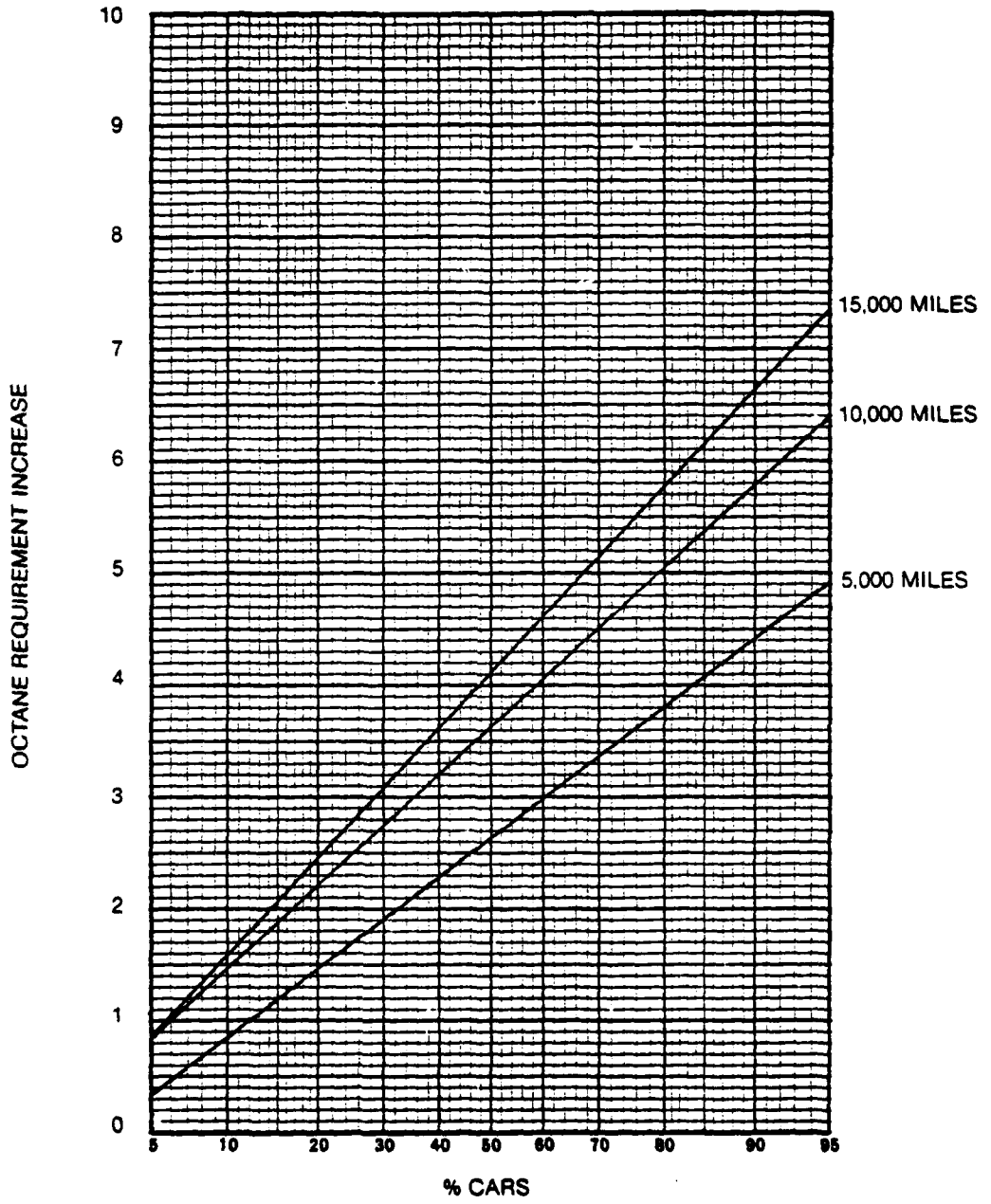


FIGURE 10

EFFECT OF INITIAL OCTANE REQUIREMENT
ON ORI AT 15,000 MILES

FBRU FUELS

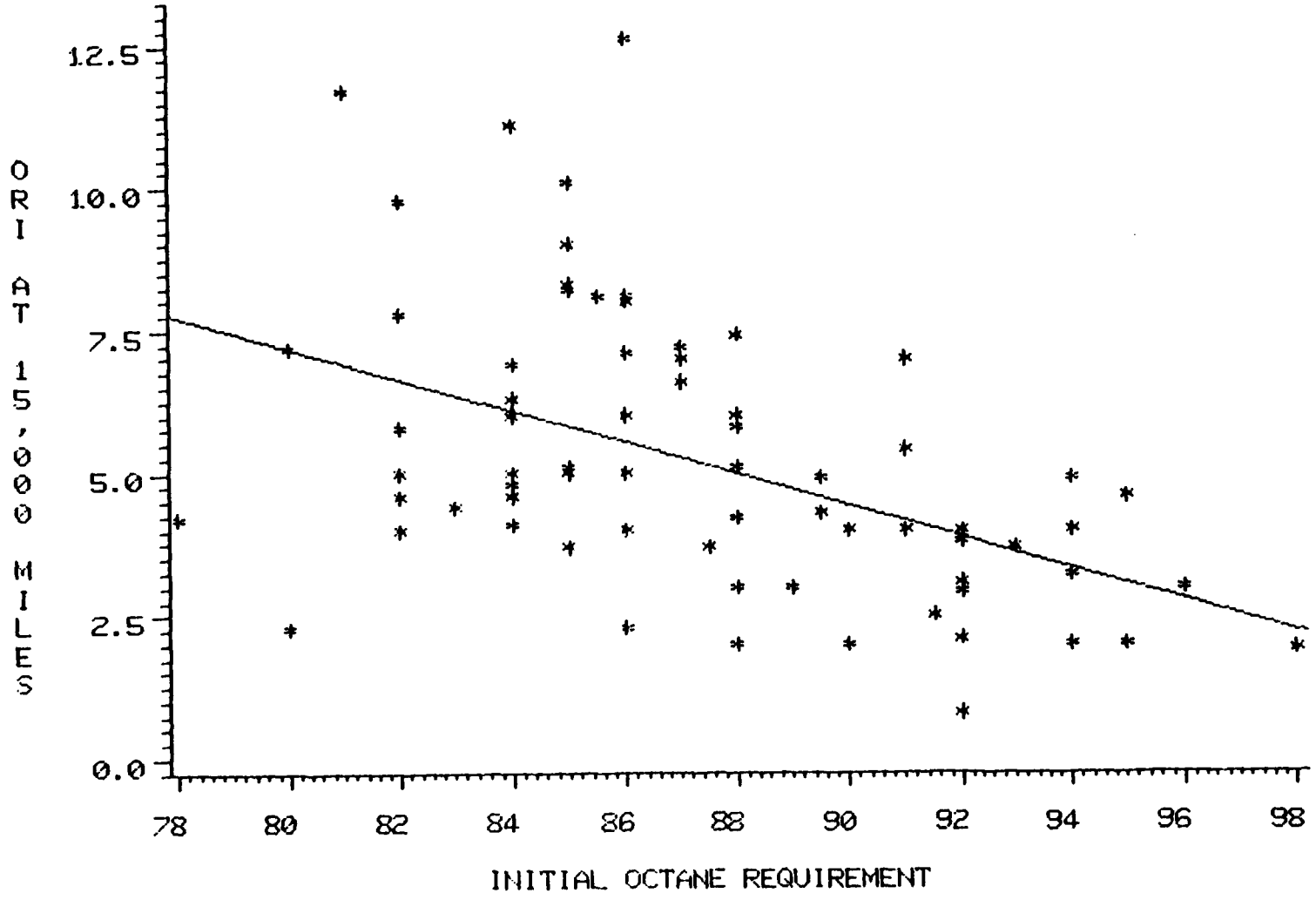


FIGURE 11

EFFECT OF INITIAL OCTANE REQUIREMENT
ON ORI AT 15,000 MILES

FBRSU FUELS

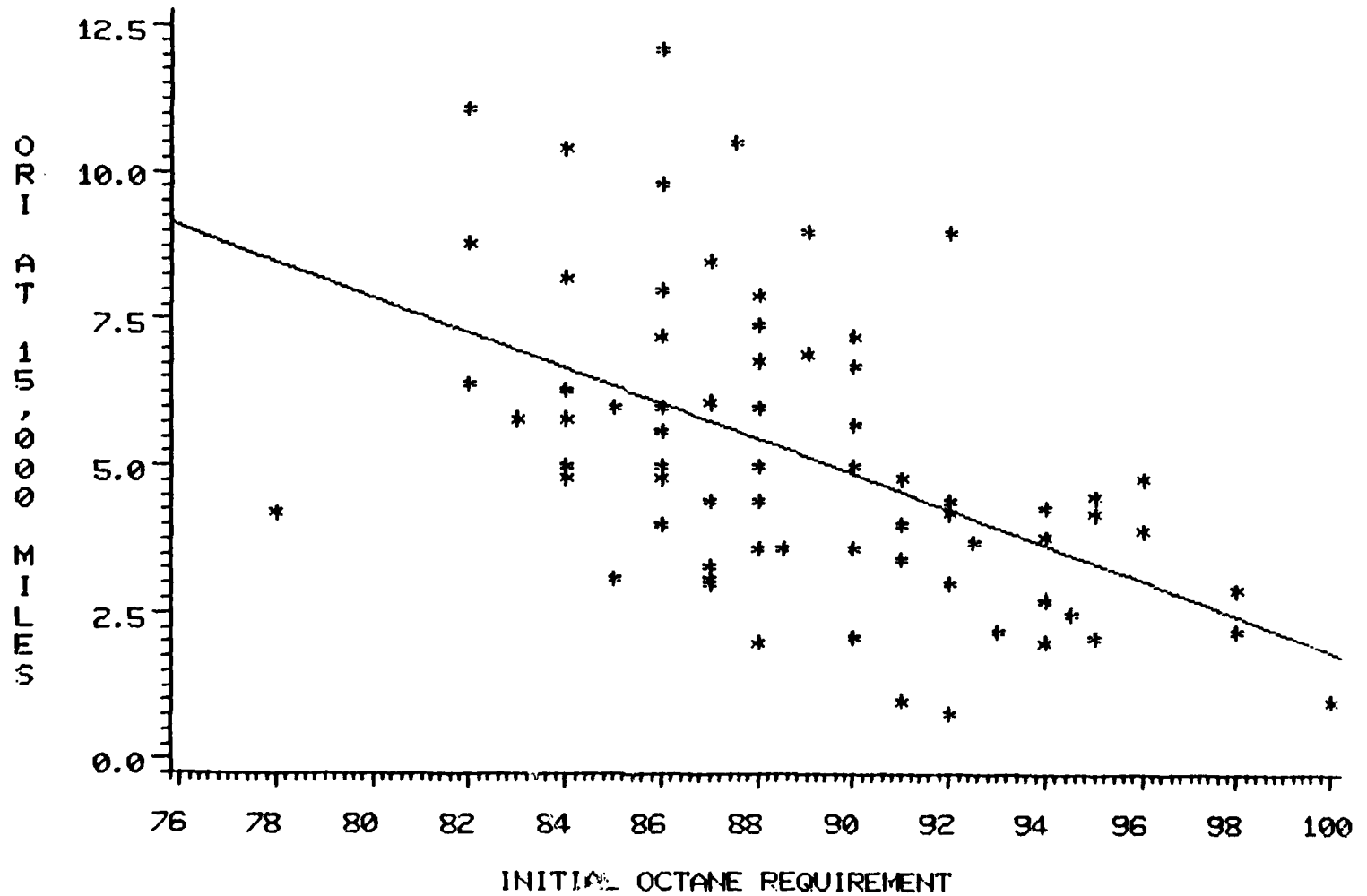
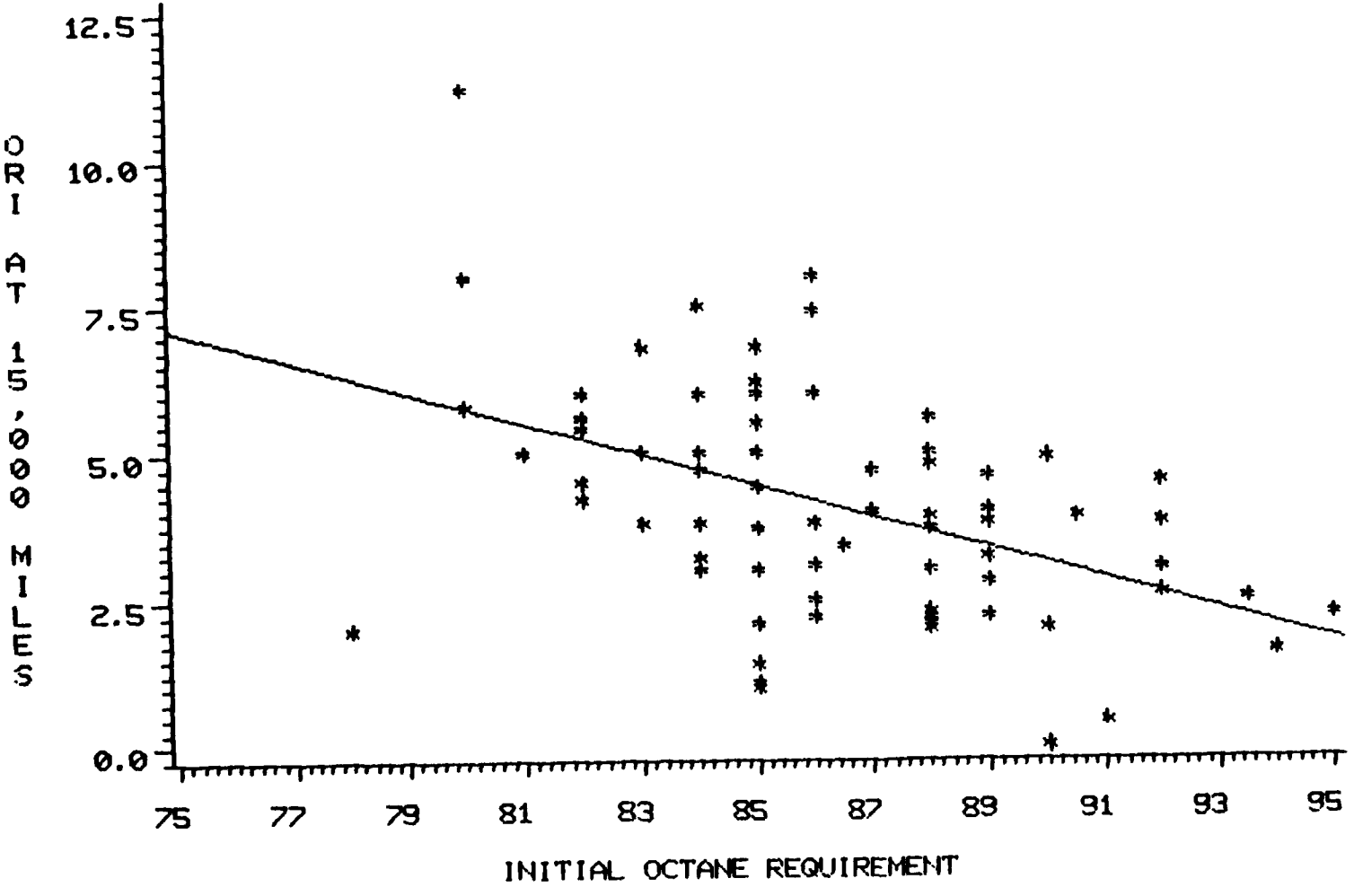


FIGURE 12

EFFECT OF INITIAL OCTANE REQUIREMENT
ON ORI AT 15,000 MILES

PR FUELS



APPENDIX A

LABORATORIES REPORTING OCTANE REQUIREMENT DATA AT VARIOUS MILEAGES

LABORATORIES REPORTING OCTANE REQUIREMENT DATA AT VARIOUS MILEAGES

Amoco Oil Company
Naperville, Illinois

General Motors Research Laboratories
Warren, Michigan

Gulf Research and Development Company
Pittsburgh, Pennsylvania

Shell Development Company
Houston, Texas

Shell Canada
Oakville, Ontario

Standard Oil Company (Ohio)
Cleveland, Ohio

Sun Tech, Inc.
Marcus Hook, Pennsylvania

Union Oil Company of California
Brea, California

APPENDIX B

MEMBERSHIP:

1981 OCTANE REQUIREMENT INCREASE DATA ANALYSIS PANEL

1981 OCTANE REQUIREMENT INCREASE

DATA ANALYSIS PANEL

Name	Company
J. B. Smith, Leader	Amoco Oil Company
J. B. Baker	Shell Development Company
D. P. Barnard	Standard Oil Company (Ohio)

APPENDIX C

REFERENCE FUEL DATA

TABLE C-I

AVERAGE SENSITIVITY FULL-BOILING RANGE UNLEADED REFERENCE FUEL SERIES (FBRU)

Research Octane No.	1981 Motor Octane No.	1980 Motor Octane No.	1979 Motor Octane No.	Lab X Motor Octane No.
78.0	74.3	74.5	74.2	73.2
80.0	76.1	75.9	75.6	74.9
82.0	77.8	77.5	77.0	76.6
84.0	79.2	78.9	78.3	78.2
85.0	79.8	79.7	78.8	79.0
86.0	80.4	80.4	79.6	79.7
87.0	81.0	81.0	80.0	80.4
88.0	81.6	81.7	80.6	81.1
89.0	82.1	82.3	81.1	81.8
90.0	82.7	83.0	81.7	82.5
91.0	83.2	83.6	82.2	83.2
92.0	83.7	84.2	82.8	83.9
93.0	84.3	84.8	83.4	84.6
94.0	84.9	85.5	84.2	85.4
95.0	85.5	86.1	84.8	86.2
96.0	86.0	86.7	85.6	87.1
97.0	86.7	87.3	86.4	87.8
98.0	87.4	88.1	87.1	88.5
99.0	88.1	88.8	88.0	89.3
100.0	88.8	89.6	88.8	90.1

TABLE C-II

HIGH SENSITIVITY FULL-BOILING RANGE UNLEADED REFERENCE FUEL SERIES (FBRSU)

Research Octane No.	1981 Motor Octane No.	1980 Motor Octane No.	1979 Motor Octane No.
78.0	72.2	72.5	72.6
80.0	73.6	74.1	73.7
82.0	75.1	75.6	75.2
84.0	76.5	77.0	76.6
85.0	77.3	77.7	77.4
86.0	78.0	78.4	78.0
87.0	78.7	79.0	78.6
88.0	79.4	79.6	79.3
89.0	80.1	80.1	80.0
90.0	80.8	80.6	80.5
91.0	81.4	81.2	81.2
92.0	82.1	81.8	81.8
93.0	82.8	82.4	82.4
94.0	83.4	83.0	83.0
95.0	84.1	83.5	83.8
96.0	84.8	84.1	84.4.
97.0	85.5	84.7	85.3
98.0	86.2	85.4	86.1
99.0	86.9	86.3	87.1
100.0	87.6	87.3	88.0
101.0	88.3	87.9	88.8

APPENDIX D

OCTANE REQUIREMENT DATA

TABLE D-I

OCTANE REQUIREMENTS FROM BEST-FIT-CURVES - FBRU FUELS

CRC Car Code	RON-Requirements at 0 Miles	5,000 Miles	10,000 Miles	15,000 Miles
HC5 225	86.0	92.5	93.8	94.1
HC5 225	88.0	92.8	93.8	94.0
HC5 225	88.0	92.0	93.0	93.1
NIK 238	92.0	93.9	94.1	94.1
NIK 238	90.0	91.8	92.0	92.0
NCX 228	82.0	85.3	86.0	86.0
NCX 228	80.0	81.8	82.3	82.3
NCX 228	80.0	85.7	87.0	87.2
LIA 238	88.0	90.4	91.6	92.2
NCX 228	82.0	85.5	86.4	86.6
NK 238	90.0	91.8	92.0	92.0
L4 441	86.0	93.3	96.3	98.6
KC 222	91.5	93.3	93.8	94.0
NC5 225	94.0	97.0	98.3	98.9
OL 216	94.0	96.2	97.0	97.2
KC 22M	87.0	90.3	92.2	93.6
L4 441	98.0	99.2	99.8	99.9
NCX 228	87.5	89.8	90.8	91.2
OL 216M	93.0	95.1	96.2	96.7
KI 252	95.0	96.2	96.8	97.0
NIA 238	95.0	97.0	98.6	99.6
KI 137	92.0	94.0	95.1	95.8
OCB 242	89.5	92.2	93.3	93.8
E 215	92.0	93.8	94.6	94.9
T 218	89.5	91.1	93.0	94.4
J 318	84.0	86.3	87.7	88.6
LCX 228	84.0	86.6	87.6	88.1
HFW 449	86.0	87.5	88.2	88.3
PC 222	84.0	87.0	88.8	90.0
PC 222	82.0	89.4	91.0	91 8
PC 222	82.0	85.8	88.2	89.8
PC 222	82.0	85.6	86.6	87.0
NC5 225	85.5	91.2	92.8	93.6
NC5 225	86.0	91.6	92.9	93.1
ML 216	81.0	86.7	90.0	92.7
J 313M	85.0	91.3	92.8	93.3
KC 222	84.0	91.7	93.9	95.1
OCA 223	88.0	90.1	90.8	91.0
PC 222	78.0	81.2	82.1	82.2
OL 216	89.0	91.2	91.9	92.0
LIA 238	91.0	95.7	97.2	98.0
OL 216	86.0	88.6	89.6	90.0
NCX 228	84.0	87.0	87.8	88.1

TABLE D-I
(Continued)

OCTANE REQUIREMENTS FROM BEST-FIT-CURVES - FBRU FUELS

CRC Car Code	RON-Requirements at 0 Miles	5,000 Miles	10,000 Miles	15,000 Miles
HIS 243	90.0	92.3	93.4	94.0
OL 216	94.0	95.4	95.8	96.0
NIJ 244	92.0	92.1	92.8	92.8
NL9 216	91.0	94.0	95.5	96.4
NCX 228	85.0	91.1	92.6	93.2
NJ 244	88.0	92.0	93.3	93.8
OL 216	96.0	97.8	98.6	99.0
E 215	92.0	95.0	95.8	96.0
T 218	87.0	92.3	93.7	94.0
IIF 243	85.0	91.8	94.0	95.1
PL 217	85.0	88.8	89.9	90.1
PC 226	92.0	94.2	95.0	95.1
T 224	85.0	88.6	89.5	90.0
MCB 223	87.0	91.6	93.4	94.2
KC 222	86.0	89.1	90.5	91.0
IIA 238	83.0	85.6	86.7	87.4
G9 F60	84.0	87.4	90.0	90.9
KL 222M	91.0	93.5	94.6	95.0
RC 242	84.0	86.5	88.5	89.0
NCX 228	84.0	87.4	89.2	90.3
NH 450	85.0	90.3	92.5	94.0
PC 226	86.0	89.2	90.0	90.0
J 318M	86.0	91.7	93.4	94.0
ML 216M	88.0	90.0	90.0	90.0
LC5 225	94.0	97.4	97.9	98.0
LC5 225	82.0	84.8	86.8	87.8
LA 238	85.0	86.4	88.3	88.7
NH 450	86.0	90.2	91.5	92.0
LY 450	84.0	87.1	88.4	88.8
OL 216	88.0	90.8	93.6	95.4
OCA 223	91.0	93.6	94.6	95.0
OV 242	88.0	91.2	93.4	94.0
KC 222M	91.0	91.3	91.6	92.0
KC 222	88.0	91.2	91.4	91.7
KC 226	85.0	90.9	92.6	93.0
RC 242	84.0	87.6	89.0	89.0
E 220M	87.0	91.2	92.6	93.1
E 220M	84.0	87.2	88.2	88.4
T 224M	87.0	92.0	92.9	93.1
T 224	86.0	90.2	90.7	91.0
OCA 223	86.5	89.0	90.2	90.8
OCA 223	89.0	93.3	94.3	94.3
IC5 225	89.0	93.1	94.4	95.0

TABLE D-II

OCTANE REQUIREMENTS FROM BEST-FIT-CURVES - FBRSU FUELS

CRC Car Code	RON-Requirements at 0 Miles	5,000 Miles	10,000 Miles	15,000 Miles
KC 222	93.0	94.8	95.2	95.2
NC5 225	96.0	98.6	99.9	100.8
OL 216	95.0	98.0	99.0	99.2
KC 22M	90.0	92.8	94.5	95.7
L4 441	100.0	100.8	101.0	101.0
NCX 228	90.0	92.4	93.3	93.6
OL 216M	95.0	97.0	98.5	99.5
KI 252	96.0	97.7	98.9	99.9
NIA 238	98.0	99.1	99.8	100.2
KI 137	95.0	96.2	96.9	97.1
OCB 242	90.0	93.7	95.5	96.7
E 215	94.5	96.2	96.8	97.0
T 218	90.0	93.5	95.6	97.2
J 318	86.0	89.2	90.7	91.6
LCX 228	87.0	89.1	89.9	90.1
HFW 449	88.0	89.8	91.0	91.6
PC 222	84.0	87.8	90.2	92.2
PC 222	84.0	90.8	92.1	94.4
PC 222	82.0	86.1	88.6	90.8
PC 222	82.0	86.0	87.6	88.4
NC5 225	87.5	92.6	95.7	98.0
NC5 225	88.0	93.6	95.2	95.9
ML 216	82.0	87.9	90.7	93.1
J 313M	86.0	91.3	92.8	93.2
KC 222	86.0	94.2	96.6	98.1
OCA 223	90.0	91.3	91.8	92.1
PC 222	78.0	81.2	82.2	82.2
OL 216	91.0	93.8	95.1	95.8
LIA 238	92.0	98.9	100.5	101.0
OL 216	88.0	92.0	93.0	93.0
NCX 228	87.0	88.8	89.6	90.0
HIS 243	92.0	94.1	94.9	95.0
OL 216	94.0	95.4	95.8	96.0
NIJ 244	92.0	92.1	92.8	92.8
NL9 216	94.0	96.4	97.3	97.8
NCX 228	87.0	92.9	94.7	95.5
NJ 244	92.5	95.6	96.2	96.2

TABLE D-II
(Continued)

OCTANE REQUIREMENTS FROM BEST-FIT-CURVES - FBRSU FUELS

CRC Car Code	RON-Requirements at 0 Miles	5,000 Miles	10,000 Miles	15,000 Miles
OL 216	98.0	99.7	100.5	100.9
E 215	94.0	96.4	97.7	98.3
T 218	92.0	95.4	96.2	96.2
IIF 243	89.0	94.8	96.8	98.0
PL 217	88.5	90.1	91.9	92.1
PC 226	94.0	96.1	96.7	96.7
T 224	86.0	89.3	90.4	90.8
MCB 223	88.0	92.4	94.1	94.8
KC 222	86.0	89.1	90.5	91.0
IIA 238	85.0	86.9	87.7	88.1
G9 F60	86.0	89.6	90.6	91.0
KL 222M	91.0	93.6	94.6	95.0
RC 242	84.0	86.6	88.6	89.0
NCX 228	84.0	87.5	89.2	90.3
NH 450	86.0	92.0	94.3	95.8
PC 226	86.0	89.3	90.0	90.0
J 318M	86.0	91.7	93.4	94.0
ML 216M	88.0	90.0	90.0	90.0
LC5 225	92.0	95.8	96.4	96.4
LC5 225	83.0	85.7	87.8	88.8
LA 238	87.0	89.0	89.9	90.3
NH 450	86.0	90.2	91.5	92.0
LY 450	84.0	87.1	88.4	88.8
OL 216	88.0	90.8	93.6	95.4
OCA 223	91.0	93.1	94.0	94.4
OV 242	88.0	91.2	93.4	94.0
KC 222M	91.0	91.3	91.6	92.0
KC 222	88.0	92.0	92.3	92.4
KC 226	86.0	92.3	93.8	94.0
RC 242	85.0	89.7	91.0	91.0
E 220M	87.0	91.2	92.6	93.1
E 220M	84.0	88.5	89.6	89.8
T 224M	87.0	92.0	92.9	93.1
T 224	86.0	90.2	90.7	91.0
OCA 223	87.0	89.8	90.9	91.4
OCA 223	90.0	94.1	94.9	95.0
IC5 225	89.0	94.2	95.6	95.9

TABLE D-III

OCTANE REQUIREMENTS FROM BEST-FIT-CURVES - PR FUELS

CRC Car Code	RON-Requirements at 0 Miles	5,000 Miles	10,000 Miles	15,000 Miles
KC 222	89.0	92.0	92.9	93.0
NC5 225	90.0	93.0	94.3	94.9
OL 216	93.5	95.2	95.8	96.0
KC 22M	86.0	88.1	89.2	89.8
L4 441	92.0	94.0	94.8	95.0
NCX 228	86.0	88.0	88.8	89.1
OL 216M	92.0	94.2	95.3	95.8
KI 252	94.0	94.9	95.5	95.6
NIA 238	88.0	90.2	91.8	92.8
KI 137	87.0	89.4	90.8	91.7
OCB 242	89.0	91.2	92.3	92.8
E 215	89.0	91.2	92.0	92.2
T 218	86.5	88.5	89.4	89.9
J 318	84.0	84.0	85.3	87.2
LCX 228	82.0	84.4	85.8	86.5
HFW 449	85.0	86.3	87.0	87.1
PC 222	82.0	85.0	87.8	88.0
PC 222	84.0	86.9	88.2	88.7
PC 222	82.0	82.2	84.4	87.4
PC 222	81.0	84.8	85.8	86.0
NC5 225	85.0	89.4	90.7	91.2
NC5 225	85.0	88.6	89.7	90.0
ML 216	80.0	85.3	88.5	91.2
J 313M	84.0	84.1	85.6	87.8
KC 222	84.0	89.6	91.1	91.5
OCA 223	86.0	87.6	88.2	88.2
PC 222	78.0	80.0	80.2	80.0
OL 216	88.0	90.1	90.9	91.0
LIA 238	90.0	91.6	92.0	92.0
OL 216	88.0	92.0	93.0	93.0
NCX 228	83.0	84.8	86.0	86.8
HIS 243	85.0	88.8	90.7	91.8
OL 216	92.0	94.2	94.6	94.6
NIJ 244	88.0	88.7	89.8	90.1
NL9 216	89.0	91.4	92.3	92.8
NCX 228	85.0	87.3	88.6	89.4
NJ 244	88.0	89.7	90.2	90.3

TABLE D-III
(Continued)

OCTANE REQUIREMENTS FROM BEST-FIT-CURVES - PR FUELS

CRC Car Code	RON-Requirements at 0 Miles	5,000 Miles	10,000 Miles	15,000 Miles
OL 216	95.0	96.6	97.1	97.2
E 215	89.0	90.5	91.4	91.8
T 218	88.0	89.5	90.0	90.2
IIF 243	83.0	87.2	89.0	89.8
PL 217	85.0	85.4	86.1	86.1
PC 226	89.0	90.8	91.2	91.2
T 224	85.0	87.3	88.3	88.7
MCB 223	86.0	90.4	92.2	93.4
KC 222	85.0	88.0	88.0	88.0
IIA 238	82.0	85.0	85.9	86.2
G9 F60	82.0	85.4	87.1	88.0
KL 222M	91.0	91.4	91.4	91.4
RC 242	80.0	84.6	86.8	88.0
NCX 228	82.0	85.1	86.6	87.6
NH 450	85.0	89.0	90.4	91.0
PC 226	85.0	86.0	86.0	86.0
J 318M	86.0	91.7	93.4	94.0
ML 216M	88.0	90.0	90.0	90.0
LC5 225	92.0	95.9	96.5	96.5
LC5 225	80.0	82.8	84.8	85.8
LA 238	85.0	86.1	86.4	86.4
NH 450	85.0	88.8	90.1	90.5
LY 450	84.0	86.3	87.0	87.0
OL 216	88.0	90.3	92.2	93.6
OCA 223	90.5	93.1	94.0	94.4
OV 242	88.0	90.2	91.4	91.9
KC 222M	90.0	90.0	90.0	90.0
KC 222	83.0	88.0	88.0	88.0
KC 226	84.0	89.3	90.0	90.0
RC 242	85.0	89.7	91.0	91.0
E 220M	87.0	90.1	91.0	91.0
E 220M	84.0	86.4	87.2	87.2
T 224M	86.0	91.1	92.0	92.0
T 224	84.0	89.0	89.0	89.0
OCA 223	86.0	87.4	88.2	88.5
OCA 223	89.0	92.2	93.2	93.6
IC5 225	88.0	90.3	91.3	91.7